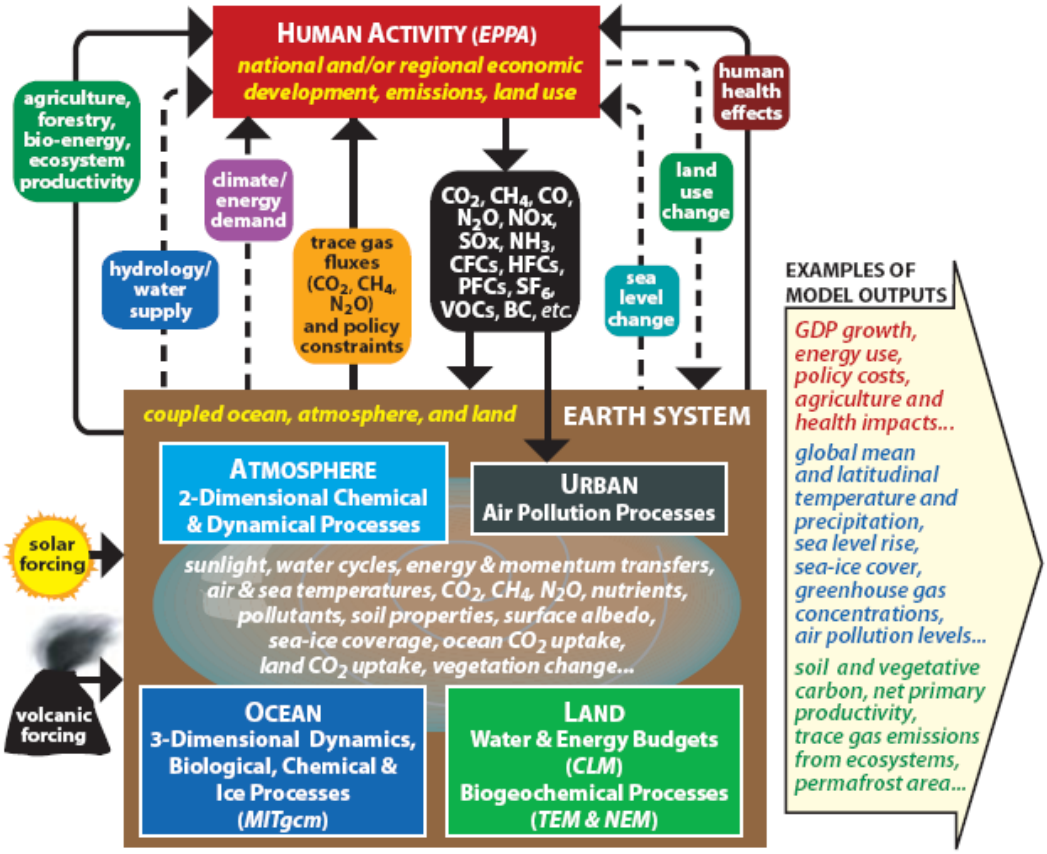
Joint Program on the Science and Policy of Global Change
Massachusetts Institute of Technology

GTAP-related activities, 2007

The MIT Joint Program on the Science and Policy of Global Change made extensive use of the GTAP data set for research and analysis conducted in the program over the past year (see the following publication list). GTAP data serves as the principal economic data for the Program's Emissions Prediction and Policy Analysis (EPPA) Model, a global CGE model of the world economy with details on the energy sector and on emissions of greenhouse gases and other air pollutants. The EPPA model is a component of the Program's Integrated Global Systems Model (Box 1), a model that represents the earth's oceans, atmosphere, and terrestrial systems as they are affected by emissions of greenhouse gases and other pollutants.

Box 1. The MIT Integrated Global Systems Model (IGSM). The EPPA model is part of a complete model of the earth system model (depicted below) that includes models of the terrestrial systems, oceans, and the atmosphere. It has been used in a variety of applications and its components and applications using the full system have been published in the peer reviewed literature. Additional reports, technical notes and journal articles describing the system and applications of it available at http://web.mit.edu/globalchange/www/reports.html



The schematic depicts the current framework and processes of the MIT Integrated Global System Model Version 2 (IGSM2).

The EPPA model was used for variety of applications. Some of them are listed below:

Studies of Policy Proposals

Implementation plans of parties that have ratified the Kyoto Protocol, and policy discussions in the U.S., include a variety of proposed measures for greenhouse gas control. The following are highlights, of our analyses of these measures.

- ***U.S. Climate Policy.*** Several cap-and-trade proposals were introduced in the U.S. Congress in 2007, each with somewhat different features. A set of representative proposals spanning the range of the actual bills was assessed by **Paltsev *et al.* (2007a)** using the recursive-dynamic version of the EPPA model. Legislation evolved over the year, and to keep current with the changes, in February 2008 an **Appendix D** to **Paltsev *et al.* (2007a**) was added that examines features in the S. 2191 sponsored by Senators Warner and Lieberman. An interesting feature of the bill is awarding of bonus allowances for carbon capture and storage (CCS), and that feature would appear likely to speed up the penetration of the technology. While emissions control featuring cap-and-trade systems has been the focus of many proposals originating in the U.S. Senate, bills introduced into the House have proposed CO_2 taxes. These proposals, and a general analysis of the pros and cons of a CO_2 or greenhouse gas tax versus cap-and-trade, are analyzed in **Metcalf *et al.* (2008)**.
- ***European Climate Policy*.** Preliminary investigations of the Kyoto Phase of the E.U. Emissions Trading Scheme (ETS) were conducted but with the specific allocations and post-2012 extension of the policy unclear we have not moved to write-up those results. With the announcement of a policy target of "20 and 20 by 2020" and the firming up of the 2008-2012 allocations there is an improved basis to proceed, which we plan to do as described below.
- ***Japanese Climate Policy*.** Analysis of Japanese climate policy continues to be a priority of the Program with the extensive analysis published in **Kasahara *et al.* (2007)** but near term policy direction in Japan is unclear at this point. Follow-up analysis of Japanese climate policy focused on specific technology options, and longer-term mitigation objectives building on stabilization scenarios will proceed in the coming year as discussed below.
- ***Canadian Climate Policy*.** Canada's emissions have grown very rapidly and they are far from meeting commitments taken under Kyoto. The politics of climate policy in Canada have also swung from support of the Kyoto Protocol to skepticism of it. Expansion of bitumen production to meet rapidly growing demands for petroleum products has been a major source of increased emissions. These competing forces, different policy proposals in Canada, and the impact on refining and bitumen production were the subject of a Master's thesis **(Anderson, 2008)**.
- ***Developing Countries and Climate Policy*.** The EPPA model was applied to China and India to investigate how fast energy consumption might grow, how this growth might affect energy markets, and what the implications will be for greenhouse gas emissions. The analysis appears in a report by **Paltsev and Reilly**

(2007a) and the wider assessment is available as presented to a conference of the Indian Council for Research on International Economic Relations **(Paltsev and Reilly, 2007b)**.

- ***Analysis of the Role of CO_2 Capture-and-Storage in Climate Policy*.** The EPPA model was applied in the MIT study of *The Future of Coal* **(Ansolabehere *et al.*, 2007)**. In the coal study results were presented only for global totals and for the U.S, and China. A paper by **McFarland *et al.* (2008)** extends these results to show the effects in the U.S., China, India, Europe, the FSU and Japan.
- ***Comparison of Assessments with Different Versions of Economic Expectations.*** Different formulations of economy models—and in particular the structure of expectations underlying the modeled decisions of firms and consumers—can yield significantly different estimates of the cost of emissions mitigation. This dual model approach was applied in the assessment of the U.S cap-and-trade proposals (**Paltsev *et al.*, 2007a; Gurgel *et al.*, 2007a**) and an analysis was conducted of the differences in results among the two model structures. A Joint Program Report that documents an exercise with a full 17-region version of the forward-looking EPPA was completed **(Babiker *et al.*, 2008)**.
- ***Development of New Scenarios of Greenhouse Gas Emissions and Atmospheric Stabilization.*** In cooperation with two other analysis groups the MIT IGSM was applied in a study organized by the U.S. Climate Change Science Program **(U.S. CCSP, 2007)**. The study was one of a set of synthesis and assessment products intended to address key questions on a two- to four-year time scale. The scenarios include a reference case and four levels of atmospheric stabilization, and they are designed to give particular attention to the technology and price implications of the stabilization targets. The study was approved and made available on the Internet in July 2007 and is now available in hard copy.
- ***Analysis of Biomass Energy at Large Scale.*** The EPPA model was applied to assessment of potential development of biomass based energy on a global scale and the economic consequences for land use and agricultural markets **(Reilly and Paltsev, 2008**; **Gurgel *et al.*, 2007b, 2008)**.
- ***Analysis of the Role of Terrestrial Sinks in Climate Policy*.** Using the enhanced EPPA-AGRI model linked to the TEM, a paper examining the role of terrestrial sinks under pressure from environmental change (CO_2, climate, ozone), increased demand for food and fiber, and a large scale biofuels market is in preparation.

***Changing Technical Requirements in Fuel Markets under Carbon Constraint*.** Forces changing energy markets are in conflict with CO_2 mitigation. Demand for transportation increases growth in gasoline, diesel, and jet fuel usage, potentially leaving excess supply of both heavier and lighter fractions. At the same time, the increasing use of heavy oils and bitumens, and possibly shale oil and coal-derived liquids, is contributing to a heavier fuel slate. Also, biofuel liquids are beginning to enter the motor fuel pool. Applying an extended version of the EPPA model, and an early exploration of the issue **(Reilly *et al.*, 2007a)**, a continuing program of work is being carried out, supported in part, as noted earlier, by a grant from BP looking at among other things the role of tar sands **(Anderson, 2008)**. An extended

paper examining this possible transition and its effects on refining capacity has been drafted and is expected to be completed in during spring 2008.

- ***Health Effects.*** A study of the United States that considered the health effects of conventional pollutants (mainly ozone and particulate matter) that also affect climate has been published **(Matus *et al.*, 2008)** and work on a paper on China is being completed. In addition initial simulations examining air pollution health effects in Europe have been completed. Underlying the model approach is an exercise in environmental accounting, and a paper is in preparation showing how the data and estimates developed for the U.S. would be incorporated into U.S. National Income and Product Accounts. If statistical agencies in the U.S. and elsewhere in the world would adopt consistent supplemental accounts for environmental effects it would greatly facilitate modeling and analysis of the links between the economy and the environment. The hope is that a paper showing exactly how the accounts could be adjusted to include environmental impacts would demonstrate the method and lead to adoption of it by statistical agencies.

2007 AND 2008 PUBLICATIONS USING GTAP (AS OF MAY 2008)

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